

conceivable conditions of climate could permit the vegetation of the neighbourhood of Disco in Greenland to be identical with that of Colorado and Missouri, at a time when little difference of level existed in the two regions. Either the southern flora migrated north in consequence of a greater amelioration of climate, or the northern flora moved southward as the climate became colder. The same argument, as Gardner has ably shown, applies to the similarity of the tertiary plants of temperate Europe to those of Greenland. If Greenland required a temperature of about 50°, as Heer calculates, to maintain its 'miocene' flora, the temperature of England must have been at least 70°, and that of the South-western States still warmer."

The author then speculates upon the former migrations of plants, and although he does not assign, like Saporta, an unvarying north and south direction, he believes that in most instances these were the lines upon which they moved. He also places a cold period between the middle cretaceous (upper cretaceous of Atané, Heer) and the lower eocene (Greenland miocene, Heer), which had not been previously noticed.

We would here remark that there is, in like manner, evidence of a cool period at the base of the English eocene. Either one relatively cool period existed at the close of the upper cretaceous of America, and another at the base of the English eocene, or else too great an age is assigned to the American series. The latter supposition is supported by Lesquereux's researches. The beds showing the more temperate conditions on the two continents are either contemporaneous or else a geological interval exists between them. Much more evidence is required before the correlation of the American and European cretaceous and tertiary rocks can be finally determined, and it is satisfactory to know that Dr. Hayden is collecting evidence on the subject.

The lower eocene flora of Greenland "established itself in Greenland, and probably all around the arctic circle, in the warm period of the earliest eocene, and as the climate of the northern hemisphere became gradually reduced from that time to the end of the pliocene, it marched on over both continents to the southward, chased behind by the modern arctic flora, and eventually by the frost and snow of the glacial age. This history may admit of correction in details; but so far as present knowledge extends it is in the main not far from the truth."

Space does not permit us to reprint the pages devoted to the various theories that have been put forward to account for former vicissitudes of climate. While allowing due weight to Croll's ingenious and well known theories, and to the larger proportion in the past of carbonic dioxide, he nevertheless is convinced of the sufficiency of the Lyellian theory of former altered distribution of land and water to account for all the facts hitherto observed.

The author conceives, however, that in some recent publications the Lyellian theory has been misconceived, but this is not exactly the case. What he here terms the Lyellian theory was really shared by many contemporary writers on physical geography, and is, that when land surfaces are aggregated round the equator and the polar oceans are wide and open, a hot period results, and that the reverse distribution induces cold, thus giving to land the heating power. The more recent theory is a modification of this, requiring masses of water, warmed under the equator, to circulate, unchilled by polar currents, and the polar oceans to be dry or else more or less closed in by land. This view he adopts.

"If North Greenland were submerged, and low land reaching to the south terminated at Disco, and if from any cause either the cold currents of Baffin's Bay were arrested, or additional warm water thrown into the North Atlantic by the Gulf Stream, there is nothing to prevent a mean temperature of 45° Fahrenheit from prevailing at Disco; and the estimate ordinarily formed of the requirements of its extinct floras is 50°,¹ which is probably above rather than below the actual temperature required."

Professor Dawson believes that to whatever causes the cold periods may be traced, they drove the warm temperate flora to the south, unless protected in insular spots by warm currents, and that on the return of warmth the plants would return northward.

"If, however, our modern flora is thus one that has returned from the south, this would account for its poverty in species as compared with those of the early tertiary. Groups of plants descending from the north have been rich and varied. Returning from the south they are like the shattered remains of a beaten army. This at least has been the case with such retreating floras as those of the lower carboniferous, the permian,

and the Jurassic, and possibly that of the lower eocene of Europe."

The great stretch north and south of the American continent favoured these migrations, and "is also connected with the interesting fact that, when new floras are entering from the arctic regions, they appear earlier in America than in Europe; and that in times when old floras are retreating from the south, old genera and species linger longer in America. Thus, in the Devonian and cretaceous new forms of those periods appear in America long before they are recognized in Europe, and in the modern epoch forms that would be regarded in Europe as miocene still exist. Much confusion in reasoning as to the geological ages of the fossil floras has arisen from want of attention to this circumstance."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

IN reply to a question in the House of Lords the other day the Duke of Richmond and Gordon stated that it was only in 1875 that it was decided to add agriculture to the syllabus of the Science and Art Department. At the first examination in May, 1876, there were only 150 candidates. By the following year 72 classes had been established, and the number of candidates rose to 800. In 1878 the classes had increased to 91, and the candidates for examination to 1,265, and this year the number of classes had reached 147; the number of persons under instruction was 2,839, of whom 2,193 came up for examination. Prof. Tanner reported that the results of the examination were very satisfactory. Fifty selected teachers, it was stated, had been brought up to London to undergo a course of training at the expense of the department.

THE two silver medals which are annually given by the Royal Geographical Society to those candidates whom the examiners deem to be most proficient in geography at the Cambridge Local Examinations have this year been awarded as follows:—Physical Geography, J. R. Davis; Political Geography, Miss Helen Jones. This, we believe, is the first occasion on which a medal has been awarded to a lady.

THE professors of the Paris Museum of Natural History having to present to the Minister of Public Instruction the names of two candidates for the lectureship of Comparative Anatomy, vacated by the death of M. Paul Gervais, have selected M. Georges Pouchet for their first candidate, and M. Jourdain for the second. The appointment of the former is quite certain.

THE number of students at the German Universities during the winter semester 1878-9 was 18,770. Berlin stands at the top of the list with 3,213, while Rostock had only 161.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 19.—"Relations between the Atomic Weights and certain Physical Properties (Melting and Boiling Points and Heats of Formation) of Elements and Compounds." By Thomas Carnelly, D.Sc., Assistant Lecturer on Chemistry in Owens College, Manchester. Communicated by Prof. H. E. Roscoe, F.R.S.

Anthropological Institute, June 24.—Mr. John Evans, F.R.S., vice-president, in the chair.—The election of the following new Members was announced:—Mr. F. Du Cane Godman, F.L.S., F.Z.S., and Mr. Percy Cotterill Wheeler, Bengal Civil Service.—Prof. W. H. Flower, F.R.S., read a paper on the osteology of the natives of the Andaman Islands. There are few people whose physical characters offer a more interesting subject for investigation to the anthropologist than the native inhabitants of the Andaman Islands. Purity of type, due to freedom from mixture with other races for an extremely long period, owing to their isolated position and their inveterate hostility to all intruders on their shores, and exemplified in the uniformity of their physical characters, is to be found among them, perhaps in a more complete degree than in any other group of mankind. The type, moreover, is an extremely peculiar one, presenting a combination of characters not found in any race of which we have at present materials for a satisfactory comparison. It is, indeed, probable that the more or less mixed and now scattered fragments of the Negrito population, found in the interior of various islands of the Indo-Malayan Archipelago, and even upon some parts of the

¹ Heer. See also papers by Professor Houghton and by Gardner in *Nature* for 1878.

mainland of Asia, may have been derived from the same stock, but the special interest of the Andamanese consists in the fact that they alone of the diminutive black, woolly-haired people, occupy the whole of the small islands, on which their ancestors have dwelt from time immemorial, or rather did so occupy them until the coming upon them of the English in 1857. The materials upon which the observations contained in the memoir are based, are far more complete than any which have hitherto been brought together, consisting of nineteen skeletons and nearly thirty skulls. The skeletons indicate an average height of 4 feet 9 inches in the males, and 4 feet 6 inches in the females, thus showing that they belong to some of the smallest of known races. The skulls all belong to what is known as the brachycephalic or round-headed type, having an average cephalic index (or proportion of breadth to length) of 82. The forehead is broad and flat, without any projection over the orbits. The nose is narrow and the jaws less prominent than in the other black races. The proportionate length of the various bones of the limbs differ greatly from the European standard, but resemble those of the negro. With the Australian the Andamanese have very little affinity, the smooth hair of the former entirely separating them, independently of cranial characters, as dolichocephaly (or long-headedness) strongly pronounced brow ridges, low orbital index, wide nasal aperture, great prognathism, &c. It is to the other woolly-haired races that we must naturally turn in endeavouring to find their nearest relatives. The Papuans and inhabitants of the Melanesian Islands differ from them greatly in their principal cranial characters, especially in the great height and narrowness of the skull. The Tasmanians had wider heads, but their facial characters were more like those of the Australians, and therefore widely different from the Andamanese. The African negroes, again, are almost all dolichocephalic, and as a general rule are extremely prognathous, and strongly platyrrhine or broad-nosed. Many of them, however, have the smooth brow and round orbits seen in the Andamanese, and not generally met with in the true oceanic negroes. The natives of the Andaman Islands, with whom may probably be associated the less known Aetas of the Philippines, the Semangs of the Malay Peninsula, thus constitute a race apart, to which the name Negrito may properly be applied. At first sight, they appear in their craniological characters to present little affinity to either of the other woolly-haired races, but it is probable that they represent a small or infantile type of the same primary group, as nearly all the characters by which they differ from the other negroes—the smaller size, smoother, and more globular heads, absence of supraorbital prominences, rounder orbits, and less projecting jaws, are those which we find in the younger individuals of a species, as compared with the older, or in the smaller species of a natural group as compared with the larger. It is very possible, but this is purely hypothetical, that the Andamanese, whose geographical position is almost midway between either extremes of the range of the woolly-haired races, may be the unchanged or little-modified representatives of a primitive type, from which the African negroes on the one hand, and the Oceanic negroes on the other, have taken their origin, and hence everything connected with their history or structure becomes of the greatest interest to the anthropologists.—The following papers were also read:—On palæolithic implements from the Valley of the Brent, by Mr. Worthington G. Smith; and Port Stewart and other flint factories of the north of Ireland, by W. J. Knowles.

Physical Society, June 21.—An extra meeting of this Society was held on the above date at Cooper's Hill Indian Engineering College, on the invitation of Col. Chesney, R.E., Lord Rosse occupying the chair.—Prof. Unwin, of the College, read a paper on experiments relating to the friction of fluids on solid surfaces against which they rub. It has long been known that a board dragged through water suffers a resistance varying in some way as the square of the velocity; that a stream takes a uniform motion at such a velocity that the component of the weight of the water down its inclined bed is balanced by the frictional drag on the bottom. The fluid in the neighbourhood of the stream is known not to move as a solid mass, the centre moving faster than the sides, and the different fluid layers rub against each other. The adhesion of the fluid to the solid against which it moves also gives rise to a sliding or rubbing action. Our knowledge of the subject has hitherto been gained from observations on pipes, streams, and from the experiments of the late Mr. Froude with a plank of wood drawn through the water of a canal. It is desirable to have a set of laboratory experiments, however, in which the conditions can be varied more

than can be done by such methods, and for this purpose the author had designed a special apparatus. In Mr. Froude's experiments there was a practically unlimited mass of water and a definitely limited extent of solid surface, and his results are not free from certain anomalies. The author thought it might be instructive to try the other case of a limited mass of water and a virtually unlimited surface. A disk in rotation gives such a surface. In some respects a cylinder would (as suggested by Prof. Ayrton) be the simplest to treat theoretically, but there are experimental difficulties in its way. The apparatus of the author consists of a metal disk rotated on a vertical axis in a vessel of water, and the problem is to determine its resistance to rotation, since this will be equivalent to the water-friction upon it. Within the outer vessel is placed a thin copper chamber, the diameter of which is unalterable, but the depth is variable at pleasure. The disk is placed concentrically inside this chamber, where there are two cheese-shaped masses of water, one above and one below the disk, which are dragged into rotation next the disk, and retarded next the sides of the pan. The couple required to rotate the disks is equal to the couple exerted by the disk or the fluid when the motion is uniform; hence the tendency of the chamber to rotate is measured, by suspending the latter from three wires in a manner similar to the bifilar suspension of magnets. An index marks whether it rotates or not on a graduated scale; and a weight suspended by a cord measures the force required to keep the index at zero. Let M be the moment of the frictional resistance of the disk, N the number of revolutions per second. Then $M = CN^x$, where C and x are constants. The author has obtained a number of results which are, however, not yet ready for publication. He mentioned, however, that a rough cast-iron disk has a frictional resistance almost exactly as the square of the velocity, whereas a turned brass disk gave a value of x decidedly less than 2. The resistance is a little greater when the mass of water is larger. These results were calculated for a speed of 10 feet per second. The author hopes to try the effect of temperature, &c., on fluid friction and viscous as well as thin fluids. Prof. Unwin also exhibited a piece of apparatus with which he hopes to study the stress of rivetted plates under shear, by means of elastic substances such as caoutchouc. He purposes to stretch the caoutchouc and photograph the appearance of stress rivetted lines upon it.—Lieut. G. S. Clark, R.E., explained the process invented by Prof. McLeod and himself for determining the absolute pitch of tuning-forks. Unlike other methods this is an optical one, and consists in arranging the tuning-fork to vibrate in front of a rotating drum whose periphery is marked with dots or fine lines at equal intervals. A microscope was arranged to comprise in its field of view the edge of the fork and several of the intervals on the drum, so that when the drum was rotated at a rate which made the speed of an interval equal to the period of the fork, a set of prominences or waves, in width equal to an interval, were visible; the body of the wave being caused by the advance and recession of the fork in its vibration. The rotation of the drum was regulated by an air-regulator devised by Prof. Unwin, the observer himself quickening or slowing the drum so as to keep the prominences steady. The time was beat by an electric clock designed by Prof. McLeod. An aniline glass pen was used to mark the beginning and end of the period of observation on the drum. A counter was also employed to give the number of revolutions. The pen and counter were actuated by electricity through the medium of a key. In these experiments a König fork giving 256 vibrations per second correct at 16°·1 C., was tested, and found to give 256·2966 vibrations per second. Frequent bowing did not alter the phase. Fixing the fork rigidly, as in a vice, did so. The temperature coefficient for König's forks (·00011 for each degree Centigrade) was confirmed by these experiments. Forks of different octaves were compared; audible beats could be counted, and modifications of Lesage's figures seen. This optical method is preferable to audible ones, because of its independence of the ear and the fact that nothing is attached to the fork itself. Prof. Guthrie inquired if the periods of the forks had been found to alter through use or magnetisation. The author said that he had not yet tested these points. Prof. McLeod instanced an old König fork which was correct at 16°·1 C., requiring now a temperature of 25° C. to make it so. Lord Rosse suggested the use of the regulators employed with equatorial clocks to keep the rotation of the drum steady. Capt. Abney inquired if a difference of vibration had been detected between the beginning and end of a series of observations. None had been certainly observed.—Prof. Macleod then described an electric clock used in the foregoing experiments. The zinc and

steel compensating pendulum moved by its own gravity, but at each beat made and broke a battery circuit by means of two bent springs, one on either side. The current passing through an electro-magnet, detained a bent lever until the pendulum swung to the other contact. By this contrivance time was marked. Prof. Macleod found that platinum contacts frequently stuck together in these experiments; but this defect had been cured by the use of a liquid shunt of dilute sulphuric acid, which destroyed the extra current. This remedy had been suggested to him by Lord Rayleigh. Prof. Macleod demonstrated the complete success of this device, which acts as well as a condenser shunt. He had also observed a curious effect with these liquid shunts, which as yet he could not explain. Two shunts having the same acid in both were employed, one shunting the extra current from four Daniell cells, and one that from two Daniell cells. The first showed evolution of H and O gas, the platinum electrodes being unaffected. The second showed no evolution of gas, but one platinum plate was dissolved away and deposited in a black powder on the other. He also exhibited a new cell formed of zinc and mercury plates, with zinc-iodide solution and mercurous chloride salt. Red iodide of mercury is formed at the negative electrode. The E.M.F. is $\frac{1}{10}$ ths of a Daniell cell, but the internal resistance very low and the cell very constant; while there is no local action. Prof. Guthrie suggested that the extra current was really a succession of sparks; the platinum might be carried bodily over from one electrode to the other. Mr. F. H. Varley stated that Mr. F. Higgins had observed a similar effect with carbon electrodes in a voltmeter, one carbon falling away into a fine powder, and due perhaps to the disintegrating action of liberated gases. He had also himself seen a platinum wire in contact with a carbon one eaten thin and drawn into very fine silky pens, while the carbon was stained blue, although the current passing was of low tension. Mr. Chandler Roberts suggested that perhaps a hydride of platinum was formed in the case mentioned by Prof. Macleod. Prof. Guthrie suggested experiments with fluorescent liquid shunts in the dark.—Mr. J. W. Clark then described some experiments on the surface tension of sulphurous anhydride, sealed in a capillary tube within a second tube, containing the same substance. He found that at low temperatures the level of the liquid is lower in the narrow than in the wide tube. As the temperature rises the meniscus in the narrow tube descends till about 156° Fahr.; it is level with that of the wider tube, both surfaces being slightly concave. Above that temperature the surfaces become plane, then convex, the level in the wide tube becoming higher than that in the narrow one. These experiments are being continued, and Mr. Clark's other results will be communicated to the Society later on.—Prof. Guthrie proposed a vote of thanks to Col. Chesney.

PARIS

Academy of Sciences, June 30.—M. Daubrée in the chair.—The following papers were read:—On the chemical constitution of alkaline amalgams, by M. Berthelot. He shows that the relative affinities of the two alkaline metals for oxygen are inverted in their amalgams. This explains the singular anomaly discovered by MM. Kraut and Topp, viz., the displacement of potassium in dissolved potash by amalgamated sodium, producing the crystallised amalgam $Hg_{24}K$. The displacement is the necessary consequence of the greater loss of energy undergone by the potassium in the formation of the amalgam.—On a peculiarity of an experiment of Gay Lussac and Thenard, by M. Debray. The experiment is that in which hydrated potash or soda in vapour are passed over an excess of well cleaned iron in a highly heated gun-barrel. Hydrogen and vapour of potassium or sodium are liberated, the oxygen being fixed in part of the iron. Gay Lussac and Thenard noticed, without explaining, that the fixation was chiefly on the metal in the part exterior to the furnace, and therefore less hot. This M. Debray attributes to the presence of vapour of the metal and of hydrogen remaining in the apparatus. From experiments by M. Sainte-Claire Deville, it may be deduced that if a mass of iron incompletely oxidised, and having its different parts at variable temperatures, be in a more or less dense atmosphere of hydrogen, the oxygen will quit the hotter parts where it was originally fixed, and go to the cooler. M. Debray illustrates the phenomena by an experiment.—Spectral examination of ytterbium, by M. Lecoq de Boisbaudran. He gives the approximate position and form of the bands, grouped chiefly between the solar lines D and F, of which the spectrum is composed.—M. Dausse was elected Correspondent in Mechanics in room of the late General Didion.—

On atmospheric waves, by M. Bouquet de la Grye. This relates to the results of some 15,000 observations of barometric height, and direction and velocity of the winds, at Brest. The numbers given as showing the maximum influence of solar and lunar action prove the greatness of this action and the impossibility of making serious predictions of weather before the atmospheric laws dependent thereon have been studied.—On the nature of the soil of the Isthmus of Gabes and the Chotts, by M. Roudaire. He gives a summary of his observations (some of which have been formerly referred to). His collections contain about 300 plant species and 120 animal, several new; he has also some 500 geological specimens, results of twenty-two borings, daily observations of atmospheric pressure, temperature, hygrometry, the wind, &c.—On Stokes's law; reply to M. Becquerel, by M. Lamansky.—On the dissociation of sulphhydrate of ammonium, by MM. Engel and Moitessier. They prove that sulphuretted hydrogen and ammonia do not combine in equal volumes at 50°, and that the supposed vapour of sulphhydrate of ammonium is merely a mixture of two gases.—Action of phthalic anhydride on naphthalene in presence of chloride of aluminium, by MM. Ador and Crafts.—On the ashes and lava of the recent eruption of Etna, by M. Cossa. The very fine blackish-grey ash is formed of fragments of crystals of triclinic felspar, augite, small grains of magnetite, and a large number of variously coloured splinters of glass. The lava is formed in great part of large crystals of triclinic felspar disseminated porphyrically in a microcrystalline magma, formed of small crystals of the same felspar, augite, magnetite, and a little greyish vitreous matter. The phenomena (in M. Cossa's opinion) tell against the hypothesis of pre-existence in the solid state of the crystalline elements in lava vomited by volcanoes.—New researches on development of the embryonal sac in angiospermous phanerogams, by M. Vesque.—On a new substance of the epidermis, and on the process of keratinisation of the epidermic coat, by M. Ranvier. The new substance, found in the form of drops in cells of the epidermis, and rapidly colourable red with carmine, he calls *eleidine*; it plays an important rôle in keratinisation of the epidermis.—On the structure of broad ligaments, by M. Guérin.—On the state of glandular cells of the submaxillary after prolonged excitation of the chorda tympani, by MM. Arloing and Renault. He concludes that these cells have a proper individuality, and are not embryonal forms of muciparous cells.—Forage in shocks of sheaves, by M. Duplessis. Green forage may be transformed into hay, in rainy weather, by arranging in shocks, and this transformation takes place more surely and economically than by the old method in the same circumstances.—On the ancient roads of the Sahara, by M. Berlioux. Some old inscriptions have been discovered by the German expedition in the Libyan Desert, on the route the author had indicated as probably a Roman road at one time.

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